B6

21. (Amended) The method of claim 1 wherein the method is provided to substantially prevent physical damage caused by a high energy particle.

REMARKS

Claims 6 and 22 have been canceled without prejudice for renewal in a related application.

Applicants have reviewed the specification and made some corrections. Here, Applicants have noticed that the patent cited in the background was incorrect due to a typographical error. U.S. Patent No. 5,403,436 should have been U.S. Patent No. 5,089,441. Applicants have amended the specification to make this correction. If this correction cannot be entered, Applicants would like to affirmatively make this of record and indicate that such typographical error was made as purely a mistake and should not prejudice the present application in any manner.

Additionally, Applicants has amended the specification to include the ratio of 1/480, which was recited in claim 8 (previously canceled). Support for the ratio was clearly in the specification in claim 8 as filed. Accordingly, Applicants have amended the specification to make it consistent with the claims. Such amendment is respectfully requested by Applicants.

Claims 1-3, 5-6, 9-11 and 21-22 are rejected under 35 USC §102 (b) as being anticipated by Moslehi (USP 5,089,441). Moslehi is directed to a conventional method, which is no more relevant than the prior art disclosed in the applications background of invention. Applicants have, however, amended claim 1 as noted, for clarification purposes. Clearly, Moslehi fails to teach each and every element of claim 1, as amended. Here, Moslehi fails to teach a method of surface treatment in a substantially downstream position of a plasma source to substantially prevent an undesirable influence of a reactive species from the plasma source, where an object to be processed is downstream from the plasma source. As recited, the method comprises generating a plasma discharge including a gas-C, the gas-C comprising a Gas-A molecule containing essentially hydrogen as an element and a Gas-B containing essentially a halogen and/or a halide; wherein said plasma discharge is substantially free from an oxygen bearing species; and wherein the Gas B is selected from chlorine, hydrogen chloride, bromine, or hydrogen bromide. Gas C comprises a flow rate defined as a ratio of an amount of hydrogen atom in Gas-B to that in Gas-A is larger than

1/480. Clearly such combination of elements including the ratio larger than 1/480 is not taught.

The Examiner has indicated that "Moslehi inherently teaches that the method provides no physical damage and also prevents undesirable influence of reactive species from the plasma source because the additive gases do not significantly affect the removal process and advantageously enhance the removal of contaminants from the wafer surface." Pages 2 and 3 of Paper 7. The Examiner cites "col. 10, lines 59-66" of the Moslehi patent. A correct reading of the Moslehi patent is as follows:

> *The addition of the HCL or HBr gas additive does not significantly affect the cleaning time for removing native oxide layer. The HCL or HBr gas additive reacts at least with some of the trace metallic contaminants, enhancing removal of those contaminants from the wafer surface during the digermane-assisted native oxide and organic contaminant removal process.* [Column 10, lines 59-66]

Clearly, the above language has nothing to do with a method that substantially prevents an undesirable influence of a reactive species from the plasma source in the manner claimed using the claimed gases and ratio. Accordingly, claim 1 is novel and patentable over Moslehi. The dependent claims 2-3, and 21 are patentable for at least the reasons noted as well as others.

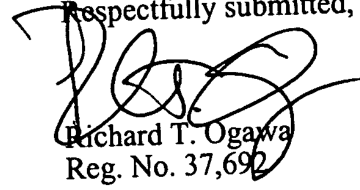
Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "**Version with markings to show changes made.**"

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,



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Version with markings to show changes made

IN THE SPECIFICATION

On page 1, replace the third full paragraph with the following:

--In the manufacture of objects such as integrated circuits, processing safety and reliability have been quite important. Fabrication of integrated circuits generally requires numerous processing steps such as etching, deposition, photolithography, and others. In the manufacture of semiconductor wafers, there have been used or proposed a variety of surface treatment methods. For example, there have been several documents which reported material surface treatments using the reaction of atomic hydrogen processed by a hydrogen containing gas plasma. Japanese Patent KOKAI H7-75229 and U.S. Patent No. 5,403,434**[6]** appeared to show an ashing method of organic materials, which was carbonized by ion implant, in a hydrogen plasma in which a concentration of atomic hydrogen was increased by adding water vapor into the hydrogen plasma.--

On page 5, replace the last full paragraph with the following:

--Among these gases, alcohol or organic acid is containing oxygen thus generating water vapor in the mixed gas plasma with hydrogen molecules. In some other gases such as silane and phosphine, they themselves are reductive. Therefore, contribution of atomic hydrogen to reductive reaction in the downstream of those gases plasma is not clearly confirmed. Actually, U.S. Patent No. 5,403,434**[6]** introduced a surface cleaning by reduction effect of germanium ("GeH4") mixed into hydrogen molecule. In addition, ammonia ("NH3") itself is well known as a reductive gas.--

On page 9, replace the third paragraph at line 14 with the following:

--Above results indicate that hydrogen-halide and halogen, which generates hydrogen-halide by reaction with hydrogen in the plasma, has the effect of transporting atomic hydrogen to downstream. U.S. Patent No. 5,403,434**[6]** mentions a dry cleaning method that objective surface is treated in the downstream of a plasma with hydrogen mixture containing HCl, HBr, or HF, or directly exposed in the downstream of a hydrogen plasma to HCl, HBr, or HF, which independently was introduced into treatment chamber. In

this document, recommended mixing amount of HCl, HBr or HF are, less than 50 SCCM for HCl or HBr into 12000 SCCM H2 and less than 10 SCCM for HF into 12,000 SCCM H2. Namely, mixing ratio of 0.42% to total gas flow is preferable for HCl and HBr and that of 0.083% is preferable for HF. From Fig. 3, however, small amount of HCl of about 0.42% scarcely has the effect of transporting atomic hydrogen. Fig. 5 shows the results of experiment used NF3 as an additive gas to hydrogen. They were not the results of HF mixing. However, almost of fluorine dissociated from NF3 probably makes HF by recombination with hydrogen during flowing from the plasma to the objective surface. Thus, HF of about 0.08% would be produced from NF3 of about 0.27% even if dissociation ratio of NF3 in the plasma was 10%. (This estimation is based on the assumption that three fluorine atoms dissociated from NF3 of 10 % makes three HF molecules.) The results obviously shows that such small amount of NF3 does not have enough level of atomic hydrogen transportation effect. Moreover, sapphire is recommended for the material of chamber wall more than quartz in U.S. Patent No. 5,403,434**[6]** to avoid degradation of the equipment. Its reason is not clarified, but phenomena is confirmed that atomic hydrogen can not be transported to the downstream even in the hydrogen-water vapor plasma when a sapphire reactor is used instead of a quartz reactor. Therefore, the recommended process in U.S. Patent No. 5,403,434**[6]** is out of range utilize atomic hydrogen and it is not possible to imagine this invention of halogen effect from U.S. Patent No. 5,403,434**[6]**. Actually, purpose of HCl or HF described in U.S. Patent No. 5,403,434**[6]** is their direct operation to the surface reaction such as elimination of metallic contaminants by HCl, thus, transporting effect of atomic hydrogen is not mentioned there at all.--

On page 14 before the last full paragraph insert the following:

--In a specific embodiment, a flow rate of molecule of hydrogen-chloride or hydrogen-bromide, which is used as Gas-B in total Gas-C flow is defined as the ratio of an amount of hydrogen atom in Gas-B to that in Gas-A is larger than 1/480.--

IN THE CLAIMS

4. (Twice Amended) A method of surface treatment in a substantially downstream position of a plasma source to substantially prevent an undesirable influence of a reactive species from the plasma source, where an object to be processed is downstream from

the plasma source, the method comprising generating a plasma discharge including a gas-C, the gas-C comprising a Gas-A molecule containing essentially hydrogen as an element and a Gas-B containing essentially a halogen and/or a halide; wherein said plasma discharge is substantially free from an oxygen bearing species; and wherein the Gas B is selected from chlorine, hydrogen chloride, bromine, or hydrogen bromide; wherein Gas C comprises a flow rate defined as a ratio of an amount of hydrogen atom in Gas-B to that in Gas-A is larger than 1/480.

5. (Twice Amended) The method of claim 1 further comprising injecting a Gas-D in the downstream of the plasma of Gas-C to treat the object comprising a surface in a downstream position of the Gas-D injection.

6. (Twice Amended) The method of claim 1, wherein using the gas B is selected from chlorine, bromine and/or iodine.

4. (Previously Canceled)

5. (Previously Amended) The method of claim 3, wherein Gas-B does not contain an oxygen atom.

6. (Canceled)

7. (Previously Canceled)

8. (Previously Canceled)

12.-20. (Previously Canceled)

21. (Amended) The method of claim 1 wherein the method is provided to substantially prevent physical damage caused by a high energy particle.

22. (Canceled)